REMARKS

1. Claims 1-4, 8-14, 19, 21-23, 27-33, and 37-43 were rejected under 35 U.S.C. 103(a) as being unpatentable over Tamura (US 4,645,754) (hereinafter "Tamura") in view of Saito (US 4,511,671) (hereinafter "Saito"). Alternatively, claims 1-4, 8-14, 19, 21-23, 27-33, and 37-43 were rejected under 35 U.S.C. 103(a) as being unpatentable over Tamura (US 4,645,754) in view of Saito (US 4,511,671) as evidenced by Murphy (US 4,358,623) (hereinafter "Murphy").

Tamura relates to the production of ethylene oxide by catalytic vapor phase oxidation of ethylene with oxygen. The invention of Tamura relates to the use of a carrier in the shape of Intalox or Berl saddles in forming the silver-based catalyst. *See U.S. Patent No. 4,645,754*, col. 2, ll. 47-56. Tamura teaches that the saddle shape of the catalyst is an improvement over Raschig rings (i.e., hollow cylinders) in that high selectivity is observed and only minimal pressure loss is observed in the catalyst bed. *See Id.* at col. 3, ll. 29-40. Further, Tamura teaches that the ratio of apparent surface area of the catalyst to the apparent volume is desired to be large. With respect to Raschig rings, Tamura teaches that a decrease in their wall thickness is effective in increasing the ratio of apparent surface area of the catalyst to the apparent volume; however, decreasing the wall thickness is disadvantageous. *See Id.* at col. 4, ll. 13-18. With respect to Raschig rings, Tamura also states:

> "Further, when the packing specific gravity in a catalyst using a carrier in the shape of spheres or Raschig rings is equalized with that in a catalyst using a porous inorganic refractory carrier in the shape of Intalox saddles or Berl saddles, the former catalyst does not acquire so high selectivity and so low pressure loss as attained by the latter catalyst." *See Id.* at col. 4, ll. 44-51.

Saito relates to the production of methacrolein by catalytic vapor phase oxidation of isobutylene or tertiary butanol with oxygen. *U.S. Patent No. 4,511,671* col. 1, ll. 6-10. As stated in the declaration submitted by Dr. Paul M. McAllister, dated February 7, 2008, Saito is a diffusion-limited reaction whereas the ethylene epoxidation reaction is not. Therefore, there are different considerations that will be taken into account for each of the different reactions. Saito teaches to increase the geometrical surface area of the hollow cylinder shaped catalyst to improve conversion performance (i.e., methacrolein

formed in the pores diffuse more quickly than in a solid cylinder reducing further reaction of the methacrolein into other compounds such as methacrylic acid, acetic acid, carbon dioxide and carbon monoxide) and improve pressure drop in the catalyst layer compared to a spherical or solid cylindrical shape. *Id.* at col. 1, ll. 35-44; col. 2, ll. 25-50.

Murphy discloses at column 3, lines 50 through 53 that "packing the tubes with small solid bodies such as beads can result in a substantial obstruction to gas flow with resulting increase in pressure drop." Murphy also discloses at column 4, lines 32 through 35 that "pressure drop through the tubes containing the balls is significantly less than that experienced with tubes packed with beads (i.e., balls of a very small size)." As discussed in the declaration by Dr. McAllister mentioned hereinbefore, this disclosure in Murphy is in agreement with the Ergun Correlation, which would predict an increase in pressure drop per unit length for beads compared to larger balls.

The Examiner asserts: "Therefore, the person having ordinary skill in the art of reactor systems for the oxidation of ethylene would have been motivated to use catalyst support materials of the type disclosed by Saito in the process of Tamura in order to achieve higher catalyst activity and higher yield while maintaining a reduced pressure drop across the catalyst bed." *See Office Communication dated April 29, 2008*, page 5, second full paragraph. As discussed in the declaration by Dr. McAllister, mentioned above, the oxidation reaction of Saito is a diffusion-limited reaction whereas the ethylene epoxidation reaction is not. Therefore, the skilled person would not have been motivated to use the catalyst support materials of the shape disclosed in Saito in the ethylene epoxidation process of Tamura in order to achieve higher catalyst activity and higher yield since Saito is a diffusion-limited reaction system with different considerations than the ethylene epoxidation reaction system.

Further, Saito does disclose that there is a decrease in pressure drop for hollow cylinder or ring-like shaped catalysts, but this is **in comparison to solid spheres or solid cylinders**. *See U.S. 4,511,671*, col. 1, ll. 39-44; col. 2, ll. 34-50. The skilled person would not have been motivated to use the catalyst support materials of the type disclosed in Saito in the ethylene epoxidation process of Tamura in order to maintain a reduced pressure drop across the catalyst bed since the improved pressure drop discussed in Saito is in comparison to solid spheres or cylinders and not the saddles of Tamura. Tamura

clearly discloses that Intalox or Berl saddles are considered superior to Raschig rings (i.e., hollow cylinders).

The Examiner also asserts: "(1) both Tamura and Saito are directed to the vapor phase oxidation of olefins (alkenes) . . . (3) Tamura notes a concern with high pressure losses associated with the use of hollow cylinder catalyst support materials . . . and (4) Saito discloses hollow cylinder catalyst support materials formed with specific dimensions that would alleviate the pressure drop concerns noted by Tamura." *See Office Communication dated April 29, 2008*, paragraph bridging pages 5 and 6. As discussed above, one skilled in the art would not be motivated to combine Tamura and Saito as they are directed to different reaction systems. Also, the improvement in pressure drop taught in Saito for hollow cylinders is in **comparison to solid spheres or solid cylinders.** Saito discloses that the improvement in pressure drop can naturally be expected. The improvement in pressure drop of the hollow cylinder (disclosed in Saito) as compared to a solid sphere or cylinder would also be predicted by the commonly accepted scientific correlation, the Ergun Correlation. The disclosure of Saito does not provide any indication that the hollow cylinders described therein would alleviate the pressure drop concerns noted by Tamura for Raschig rings (i.e., hollow cylinders). Tamura clearly teaches away from using hollow cylinders. Thus, the skilled person would not have been motivated to use the hollow cylinder catalyst support materials described in Saito to alleviate the pressure drop concerns noted by Tamura.

Moreover, in light of the additional evidence provided in the declaration by Dr. McAllister, mentioned above (see in particular points 6-9), it is **unexpected** that the combination of a large tube diameter (i.e., at least 28 mm) and a hollow cylinder geometry for nominal 8, 9, 10, and 11 mm supports having a small inside diameter, according to the present invention, would result in an improved balance of tube packing density relative to the pressure drop across the packed bed. Prior to the present invention, the skilled person would have looked to the Ergun Correlation to predict pressure drop, and therefore, would have expected that support shapes with such small internal diameters would not be acceptable for commercial ethylene oxide production (i.e., the pressure drop would be too high).

Thus, claim 1 is non-obvious over Tamura in view of Saito, or alternatively over Tamura in view of Saito as evidenced by Murphy. The arguments above also apply to claim 19; therefore, claim 19 is also non-obvious over Tamura in view of Saito, or alternatively over Tamura in view of Saito as evidenced by Murphy. The remaining claims depend from claims 1 or 19; therefore, they are also non-obvious over over Tamura in view of Saito, or alternatively over Tamura in view of Saito as evidenced by Murphy. Applicants respectfully request the rejection be withdrawn.

Allowance of the claims of the present application is respectfully requested. Should any fee be due in connection with the filing of this document, the Commissioner for Patents is hereby authorized to deduct said fee from Shell Oil Company, Deposit Account No. 19-1800. If the Examiner would like to discuss this case with Applicant's attorney, the Examiner is invited to contact Lisa Holthus at the phone number below.

Respectfully submitted,

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